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RECENT INCIDENTS OF ARSINE POISONING

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ABSTRACT

Two incidents of arsine poisoning are described. In one a new process of treating aluminium and zinc dross was used and this resulted in eight men becoming severely affected, one fatally. The results of analysis and air sampling are given. In the other incident a well-recognised method of dipping metal objects in a solution containing arsenic was the cause of the incident. The results of analysis of hair samples in workers on this process are given.

Arsine poisoning has been well recorded both in the scientific and general industrial journals. However, episodes still occur all too frequently mainly because people do not remember how common a contaminant arsenic is, particularly in zinc and aluminium residues. Arsenic may occur in some natural rock in concentrations of up to 10000 mg/kg and also occurs in soil and coal. It also occurs in small amounts in foodstuffs, often as a result of compounds of arsenic being used as preservatives or as colourants or in the wrapping material.

WORKING CONDITIONS AND CLINICAL COURSE

In the first incident I shall describe, eight men were poisoned when a new non-heat process for the recovery of metals was used. In this process zinc and aluminium bearing dross was being treated by revolving it in a ball mill for about an hour and then passing air over it to carry away any ash. The enriched material was then discharged at the bottom of the mill. The initial feedstock for this process was delivered by lorry to the plant and discharged on the ground and then mechanically shovelled to the area of the ball mills being finally hand--shovelled into the mills themselves. These were contained in a shed approximately 10 metres by 10 metres by 6 metres high. A trial load was processed and this went through without incident. A week later the feedstock for the first production run was left uncovered during its journey from the supplier and became wet due to a rainstorm. As soon as it arrived work commenced, five men in all loading the ball mills. Two hours after this work commenced the men shovelling the feedstock began to feel drowsy. They all complained of severe

generalised headaches. Collapse rapidly followed and they were all transferred to hospital. Three other men who entered the shed a few minutes later, presumably to see what had gone wrong, were subsequently affected and required admission to hospital later that day. The shed was then locked and sealed pending the arrival of the investigating team a few hours later. At the hospital the typical signs and symptoms of arsine poisoning rapidly appeared, including severe haemoglobinuria. Exchange transfusion was performed on all eight men and four of them were placed on renal dialysis. One of these four died three weeks after the incident occurred. The full details of the immediate clinical course of those patients is to be published by the consultant in charge of their case. Of the seven men who recovered, four have now returned to full work. The other three have not and are still showing signs mainly of a neurological nature including difficulty in walking and standing. They also show disturbance of speech and memory and psychological changes. They still have not returned to any work, even though two years have passed since the incident occurred.

SAMPLING RESULTS

The feedstock material containing the arsenic came from a zinc recovery plant and was stored there in an open tip in the middle of an urban area. The composition of the metals present was: arsenic up to 28%, aluminium up to 31% and zinc up to 25%. Sampling for arsine at the ball mills some 24 hours after the incident occurred showed that its concentration beside stock compound was 72 mg/m^3, inside shovel of tipper truck untreated material 100 mg/m^3 and inside shovel of tipper truck treated material 1.0 mg/kg. The arsine present remained in the shed and this was convincingly proved by a member of the investigating team who unwisely entered the shed not wearing any protective breathing apparatus for about 10 minutes. He developed severe haemoglobinuria and anaemia within 24 hours.

TABLE 1
Arsine sampling results in mg/m^3 from tip supplying feedstock.

Position	Dry conditions	After rain
1	22.4	50
2	1.0	60
3	10	8
4	0.8	0.4

An incident as severe as this naturally aroused considerable publicity and some alarm at the premises where the feedstock was produced. The sampling results in Table 1 show the amount of arsine present on the tip. The men working there were all examined and urinary arsenic estimations were undertaken on the 119 men who had had any direct contact with the tip. These results, together with the haemoglobin estimations on these men were all within

normal limits for persons exposed to arsenic. A questionnaire noted that no one complained of any symptoms that might have been related to arsine exposure and, in particular, there had been no cases of haematuria.

STEEL BRONZING

Steel bronzing is a process whereby a decorative or antique type look is given to metal articles, such as wall plaques, door-knockers and the like. The steel bronze consists of a solution of arsenic and ferric chloride in hydrochloric acid. The articles to be treated are first cleaned and then dipped into the bronzing solution on wires or in baskets. After removal they are washed in water, scratch polished and lacquered. At least two cases of fatal arsine poisoning had been recorded by HM Factory Inspectorate over the years. In this recent incident zinc hinges were accidentally dipped into the steel bronze solution. The youth doing this became unwell an hour or so after work. The diagnosis of arsine poisoning was quickly made by the hospital and with general supportive treatment he recovered. Subsequent air sampling results taken at his place of work showed that arsine concentration at the lip of tank before work was 2.6 mg/m^3 and during work 0.28 mg/m^3. Its concentration at washing tank was considerably lower (0.09 mg/m^3).

Neutron activation analysis demonstrated a raised arsenic content of the hair from the head and the fingernails in all four of the workers from the factory where the incident occurred. These are shown in Table 2 together with the normal range as supplied by the laboratory.

TABLE 2
Arsenic in mg/kg in hair and nails of workers determined by neutron activation analysis.

Worker	Hair	Nails
1	71.5	15.0
2	76.1	188.0
3	10.8	18.6
4	64.77	123.0
Normal range	0.038 – 0.53	0.006 – 0.51

GENERAL REMARKS

Returning to the first incident, even now some of those affected are still showing symptoms both of a psychiatric and neurological nature. With modern methods of treatment, including exchange transfusion and prolonged renal dialysis, more and more victims of what was usually a previously fatal occurrence are going to survive. Some of these, however, will have permanent damage.

Epidemiological information on arsine poisoning is lacking and the chronic long-term effects still require considerable study. Although this paper concentrates on two incidents, I am sure that many of the readers can think of other possible sources of exposure where chance poisoning may still occur.

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